56. The method of Claims 45, where the compressive stress inducing layer comprises silicon oxide or silicon nitride.

57. The method of Claim 45, where the refractory metal silicide layer comprises titanium silicide.

C3 Cancel

58. The method of Claim 57, where the first crystalline phase is C49 and the second crystalline phase is C54.

REMARKS

Claims 22, 24-26 and 45 were pending in the above referenced application. Claims 22, 25 and 26 are canceled without prejudice. Claims 24 and 45 are amended and Claims 52-58 are added. It follows then that Claims 24, 45 and 52-58 are currently pending and reconsideration of the instant application is respectfully requested.

Rejection under 35 U.S.C. §112

Claims 22, 24-26 and 45 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as his invention. Applicant has canceled Claims 22, 25 and 26 and has amended Claims 24 and 45. While Applicant's amendments are somewhat different from those graciously suggested by the Examiner, Applicant believes that such amended claims are

fully in compliance with all of §112 and hence requests that the instant rejection is withdrawn.

Rejections under 35 U.S.C. §102:

Kawamura et al

Claim 45 stands rejected under 35 U.S.C. §102(a) as being anticipated by Kawamura et al. (JP 8139056) (hereinafter Kawamura). Applicant traverses.

Claim 45 is amended to recite, among other things, "forming a compressive stress inducing material layer over a first side of a substrate" and "forming a refractory metal silicide over the compressive stress inducing material layer." In each of Kawamura's figures and in the translation of the text describing those figures, Kawamura NEVER discloses that both the compressive stress inducing material layer and the refractory metal layer are formed on or over the same side of a substrate. Therefore, absent such a teaching, Kawamura CANNOT be the basis of a rejection under §102 as such a rejection must disclose all limitations of that which is claimed. Applicant respectfully asserts, therefore, the rejection of Claim 45 be withdrawn and such claim be allowed.

Applicant has also added Claims 52-58 which depend from Claim 45. Therefore, Applicant asserts that such dependent claims are also in condition for allowance for at least the same reason as provided above for Claim 45. Action to this effect is earnestly sought.

Huang et al

Claims 22, 25 and 26 stand rejected under 35 U.S.C. §102(a) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Huang et al., [The Influence of Ge-Implanation on the electrical characteristics of the Ulta-Shallow Junction Formed by Using Silicide as a diffusion, IEEE Electron Device Letters, Vol 17 Issue 3, March 1996, pp 88-90] (hereinafter "Huang"). Claims 22, 25 and 26 are canceled above, without prejudice. Therefore the rejection of such claims is made moot.

Cabral et al.

Claims 22, 24-26 stand rejected under 35 U.S.C 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Cabral et al [US 5,828,131] (hereinafter "Cabral"). As mentioned above, Claims 22, 25 and 26 are canceled without prejudice making the rejection of such claims moot. Therefore Applicant traverses only the rejection of Claim 24.

Claim 24 is amended to recite, in pertinent part, "forming a titanium metal layer over a silicon containing substrate," "providing stress inducing atoms into the titanium metal layer, the compressive stress inducing atoms being larger than silicon atoms" and "after the providing, first annealing the titanium metal layer containing the compressive stress inducing atoms to form a titanium silicide layer substantially of a first crystalline phase"

In contrast, Cabral NEVER discloses forming a titanium layer where compressive stress inducing atoms are provided into the titanium film before an annealing. Referring to column 3 at the beginning of the section "Description of the Invention" and continuing through column 5, line 25, in each of the several embodiments Cabral discloses, either a layer of titanium silicide is formed **prior to any anneal** or a layer of titanium is formed over a refractory metal layer, or at least a surface of the silicon substrate comprising atoms of such a refractory metal, where it is not until the anneal for forming the silicide that such refractory metal atoms are introduced into the titanium silicide layer. Applicant notes that while Cabral does disclose that elements such as germanium can be incorporated in a precursory metal layer (col. 3,

lines 60-64), that such precursory layer is the Ti-silicon alloy thus the elements discussed are in ADDITION TO SILICON.

Applicant respectfully asserts, therefore, that Cabral NEVER discloses or suggests forming a titanium layer, adding compressive stress inducing atoms into the layer and subsequently annealing the layer of titanium comprising the compressive stress inducing atoms to form a titanium silicide material such as recited in Claim 24. If follows then that absent such a teaching or disclosure, the instant rejection under §102, which requires that all aspects of the rejected claim be taught by the cited art, CANNOT be maintained and hence must be withdrawn.

With regard to the alternative rejection under §103, Applicant respectfully contends that Examiner's rejection is unclear as to that which might be obvious in view of Cabral. Thus while the Examiner refers to various sections of Cabral that disclose the forming of a Ti-alloy layer (see, page 7, lines 4-5 of the Office Action), none of these sections disclose or even suggest the forming of a titanium layer and adding compressive stress inducing atoms to the formed layer such as Applicant recites in Claim 24. Thus for at least this reason, Applicant respectfully asserts that the alternate rejection under §103 also CANNOT be maintained and hence must be withdrawn.

Withdrawal of the instant rejections with respect to Claim 24 and allowance of such claim is earnestly sought.

Agnello et al

Claim 24 stands rejected under 35 U.S.C. 102(e) as anticipated or, in the alternative, under 35 U.S.C. 103(a) as obvious over Agnello et al [US 5,608,266] (hereinafter "Agnello"). Applicant traverses.

Claim 24 is amended to specifically recite forming a titanium layer and a titanium silicide layer therefrom. Agnello only discloses cobalt films, alloys and silicides. Therefore absent any disclosure of titanium films or titanium silicide, the rejection under §102, requiring that every aspect of that which is claimed be disclosed in the cited art, CANNOT be maintained. It necessarily follows that the instant rejection be withdrawn. Action to this effect is sought.

Kitano et al.

Claim 22 stands rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Kitano et al [US 5,665,646] (hereinafter Kitano). Claim 22 is canceled above, therefore the instant reject is moot..

Rejections under 35 U.S.C. §103(a):

Claims 24-26 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kimato [US 5,665,646] (hereinafter Kimato) in view of Apte et al [US 5,593,924] (hereinafter Apte). Claims 25 and 26 are canceled above making the rejection of such claims moot. Applicant traverses the rejection of Claim 24.

As pointed out above, Claim 24 recites forming a titanium layer, providing compressive stress inducing atoms into the layer and subsequently

annealing the layer to form titanium silicide. Kitano, the primary reference, discloses first forming an amorphous titanium silicide layer by first annealing at a temperature below about 400 degrees Celsius (see, col. 4, line 66 - col. 5, line 5). Only after such an amorphous layer is formed does Kitano disclose adding As atoms, thus where the Examiner suggests that the As of Kitano could be replaced by the Ge of Apte, even where such a modification is made, the combination of Kitano and Apte do not disclose or suggest all aspects of the invention recited in Claim 24. As such is a requirement to maintain a rejection under § 103 (see, M.P.E.P. §2403.03), The instant rejection MUST be withdrawn. Action to this effect is earnestly sought.

With regard to added Claims 52-58, each of such claims depend from an independent claim which applicant has argued is in condition for allowance. Thus, for at least the same reasons presented for respective independent claims, Claims 52-58 are also in condition for allowance as presented.

In summary, Applicant having responded to each of the rejections and objections, respectfully asserts that Claims 24, 45 and 52-58 are in condition for allowance. Action to that effect is earnestly sought. If, however the Examiner's next action is anything other than a Notice of Allowance, the Examiner is requested to call the undersigned to schedule a telephonic interview. The undersigned is available during normal business hours, Pacific Coast Time.

Respectfully submitted,

Dated: Sep 28, 2001 By: _____

Bernard Berman
Reg. No. 37,279

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. 09/233/377
Filing Date ..... January 18, 1999
Inventor ..... Gurtej S. Sandhu et al.
Assignee ..... Micron Technology, Inc.
Group Art Unit 2813
Examiner ..... T. Pham
Attorney's Docket No. MI22-1114
Title: Method of Forming a Refractory Metal Silicide (as Amended)

VERSION WITH MARKINGS TO SHOW CHANGES MADE ACCOMPANYING RESPONSE TO JUNE 28, 2001 OFFICE ACTION

The claims have been amended as follows. Underlines indicate insertions and ~~strikeouts~~ indicate deletions.

Cancel Claim 22.

24. A method of forming a refractory metal silicide layer comprising:

forming a ~~refractory~~ titanium metal ~~silicide~~ layer ~~of a first crystalline phase~~ over a silicon containing substrate;

providing stress inducing atoms into the titanium metal layer, the compressive stress inducing atoms being larger than silicon atoms;

after the providing, first annealing the titanium metal layer containing the compressive stress inducing atoms to form a titanium silicide layer substantially of a first crystalline phase; and

~~providing compressive stress inducing atoms within the refractory metal silicide of the first crystalline phase, the compressive stress inducing atoms being larger than silicon atoms of the silicide;~~

~~with the compressive stress inducing atoms within the first phase refractory metal silicide of the first crystalline phase,~~ second annealing the ~~refractory metal~~ titanium silicide layer of the first crystalline phase under conditions effective to transform said titanium metal silicide layer to a more dense layer substantially of a second crystalline phase~~; and~~

~~further comprising *in situ* providing the compressive stress inducing atoms into a refractory metal layer during deposition of said refractory metal layer over an underlying silicon containing substrate; and~~

~~annealing the refractory metal layer to form said refractory metal silicide of the first crystalline phase from the refractory metal and silicon of the underlying substrate~~.

Cancel claims 225 and 26.

45. A method of forming a refractory metal silicide comprising:

forming a compressive stress inducing material layer over a first side of a substrate;

forming a refractory metal ~~on a first side of a silicon containing substrate~~ silicide over the compressive stress inducing material layer, the refractory metal silicide comprising a first crystalline phase;

~~providing a compressive stress inducing material proximate the refractory metal;~~

after ~~providing the compressive stress inducing material~~ forming the refractory metal silicide, annealing the refractory metal to form a refractory metal silicide of a ~~first~~ second crystalline phase ~~from the refractory metal and silicon of the underlying substrate~~;

~~annealing the refractory metal silicide of the first crystalline phase to transform the first phase silicide to a more dense second crystalline phase; and~~

~~comprising providing the compressive stress inducing material under the first crystalline phase refractory metal silicide~~.